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भाग 1 सुरक्षा अपेक्षाएँ

Indian Standard

SINGLE-CAPPED FLUORESCENT LAMPS

PART 1 SAFETY REQUIREMENTS

ICS 29.140.30

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 2006

Price Group 10

Electric Lamps and Their Auxiliaries Sectional Committee, ET 23

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electric Lamps and Their Auxiliaries Sectional Committee had been approved by the Electrotechnical Division Council.

The lamps covered under these standards are single-capped fluorescent lamps for general lighting purposes having a single cap, for operation on external circuits with either an internal or an external means of starting.

This standard (Part 1) covers only safety requirements. The performance requirements will be covered in Part 2 of this standard.

This standard is based on IEC Pub 61199 (1999) 'Single-capped fluorescent lamps — Safety specifications' issued by the International Electrotechnical Commission (IEC) with the following modifications:

Lamps with 2G7, 2G11, G23, G24, and GX24 caps have been covered.

Data sheets on caps and gauges have been incorporated.

Data sheets on caps and gauges have been taken from IEC 60061-1 'Lamp caps and holders together with gauges for the control of interchangeability and safety — Part 1: Lamp caps' and IEC 60061-3 'Lamp caps and holders together with gauges for the control of interchangeability and safety — Part 3: Gauges'. The data sheet number allotted in this standard is in line with corresponding IEC Publications.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SINGLE-CAPPED FLUORESCENT LAMPS

PART 1 SAFETY REQUIREMENTS

1 SCOPE

This standard (Part 1) specifies the safety requirements for single-capped fluorescent lamps for general lighting purposes for all groups having 2G7, 2G11, G23, G24, and GX24 caps.

It also specifies the method a manufacturer should use to show compliance with the requirements of this standard on the basis of whole production appraisal in association with the test records on finished products. This method can also be applied for certification purposes. Details of a batch test procedure which can be used to make limited assessment of batches are also given in this standard.

NOTE — Compliance with this standard concerns only safety criteria and does not take into account the performance of single-capped fluorescent lamps for general lighting purposes with respect to luminous flux, colour, starting and operational characteristics which would be covered in Part 2 of this standard.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision and parties to agreement based on this standard are encouraged to investigate the possibility of applying the more recent editions of the standards indicated below:

IS No.	*Title*
2500 (Part 1) : 2000	Sampling inspection procedures: Part 1 Attribute sampling plans by acceptable quality level (AQL) for lot-by-lot inspection (*third revision*)
10322 (Part 1) : 1982	Luminaries: Part 1 General requirements
11000 (Part 2/ Sec 1) : 1984	Fire hazard testing: Part 2 Test methods, Section 1 Glow wire test and guidance
12063 : 1987	Classification of degree of protection provided by enclosures of electrical equipment

3 TERMINOLOGY

For the purpose of this standard the following definitions shall apply.

3.1 Single-Capped Fluorescent Lamp — Low-pressure mercury discharge lamp having a single cap in which most of the light from the lamp is emitted by a layer of fluorescent material excited by the ultraviolet radiation from the discharge.

3.2 Group — Lamps having the same electrical and cathode characteristics, the same physical dimensions and the same starting method.

3.3 Type — Lamps of same group having the same photometric and colour characteristics.

3.4 Family — Lamp group which are distinguished by common features of materials, components, tube diameter and/or method of processing.

3.5 Nominal Wattage — Wattage used to designate the lamp.

3.6 Design Test — Test made on a sample for the purpose of checking compliance of the design of a family, group or a number of groups with the requirements of the relevant clause.

3.7 Periodic Test — Test, or series of tests repeated at intervals in order to check that a product does not deviate in certain respects from the given design.

3.8 Running Test — Test repeated at frequent intervals to provide data for assessment.

3.9 Batch — All lamps of one family and/or group and identified as such and put forward at one time for test or checking compliance.

3.10 Whole Production — Production during a period of twelve months of all types of lamps within the scope of this standard for inclusion in the certificate.

4 SAFETY REQUIREMENTS

4.1 General

Lamps shall be so designed and constructed that in normal use they present no danger to the user or the surroundings.

In general, compliance is checked by carrying out all the tests specified.

4.2 Marking

4.2.1 The following information shall be legibly and durably marked on the lamps:

a) Mark of origin (this may take the form of a trade-mark, the manufacturer's name or the name of the responsible vendor);

b) The nominal wattage (marked W or Watts) or any other indication which identifies the lamp; and

c) Country of manufacture.

4.2.2 Compliance is checked by the following:

a) Presence and legibility of the marking by visual inspection; and

b) Durability of marking by applying the following test on unused lamps.

The area of the marking on the lamp shall be rubbed by hand with a smooth cloth damped with water for a period of 15 s.

After this test, the marking shall still be legible.

4.2.3 *BIS Certification Marking*

The lamps may also be marked with the Standard Mark.

4.2.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

4.3 Mechanical Requirements for Caps

4.3.1 *Construction and Assembly*

Caps shall be so constructed and assembled to the tube(s) that the whole assembly remains intact and attached during and after operation.

Compliance is checked by carrying out the tests given in Annex A.

At the end of the tests, the caps shall show no damage that impairs safety.

4.3.2 *Dimensional Requirements for Caps*

4.3.2.1 Lamps shall use standardized caps in accordance with dimensional requirements given in relevant data sheets.

4.3.2.2 Compliance is checked by using the gauges as per relevant data sheets shown in Table 1.

4.3.3 *Pin Connections and Keying Configurations*

4.3.3.1 *Pin connections*

The connection of lamp cathodes to the pins of caps having four pins shall confirm to the requirements shown in Annex B for the relevant cap.

Compliance is checked by electrical continuity test between relevant pins and/or by visual inspection.

4.3.3.2 *Key configurations*

For those cap types incorporating keys which ensure non-interchangeability with similar lamp types, the caps shall confirm to the cap/key version given in the relevant lamp data sheets.

Annex C gives guidance to which cap/key shall be used when designing lamps to operate on certain ballast.

Compliance is checked by a suitable measuring system and/or visual inspection.

4.4 Insulation Resistance

4.4.1 The insulation resistance between the metal parts, if any, of the cap and all pins connected together shall not be less than 2 M Ω.

4.4.2 Compliance is checked by measurement with suitable test equipment using a dc voltage of 500 V.

In the case of caps made entirely from insulating material, the test is made between all pins connected together and metal foil wrapped over those surface that are accessible when the cap has been connected to a lamp holder with minimum shrouding dimensions as given in relevant data sheets.

4.5 Electric Strength

4.5.1 The insulation between the same parts as those referred to in **4.4** shall withstand the test voltage of **4.5.2**. No flash-over or breakdown shall occur during the test.

4.5.2 Compliance is checked with a 1 500 V a.c. voltage of substantially sine-wave form, with a frequency of 50 Hz and applied for 1 min. Initially, not more than half the prescribed voltage shall be applied; it shall than be raised rapidly to the full value.

Glow discharges without a drop in voltage are neglected.

4.6 Parts which can Become Accidentally Live

4.6.1 Metal parts, if any, intended to be insulated from live parts shall not be or become live.

4.6.2 With the exception of cap pins, no live part shall project from any part of the cap.

4.6.3 Compliance is checked by a suitable measuring system which may include visual inspection where appropriate. In addition, there shall be regular daily checks of the equipment or a verification of the effectiveness of the inspection (*see* **5.5.4**).

4.7 Resistance to Heat and Fire

4.7.1 Insulating material of caps shall be sufficiently resistant to heat.

4.7.2 Compliance is checked by the following tests.

4.7.2.1 Samples are tested for a period of 168 h in a heating cabinet at a temperature as given in Annex D.

At the end of the test, the samples shall not have undergone any change impairing their future safety, especially in the following respect:

a) reduction in the protection against electric shock as required in **4.4** and **4.5**; and

b) loosening of cap pins, cracks, swelling, and shrinking as determined by visual inspection.

At the end of the test, the dimensions shall comply with the requirement of **4.3.2**.

4.7.2.2 Samples are subjected to a ball-pressure test by means of the apparatus shown in Fig. D-1.

The surface of the part under test is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against this surface by a force of 20 N. If the surface under test bends, the part where the ball presses shall be supported.

The test shall be made in a heating cabinet at a temperature of 125° ± 5°C.

After 1 h the ball shall be removed and the diameter of the impression measured. This diameter shall not exceed 2 mm.

The test shall not be made on parts of ceramic material.

4.7.3 Insulating material of caps shall be resistance to abnormal heat and to fire.

4.7.4 Compliance is checked by the following test.

Parts are subjected to a test using a nickel-chromium glow-wire heated to 650°C as described in IS 11000 (Part 2/Sec 1).

The sample to be tested is mounted vertically on the carriage and pressed against the glow-wire tip with a force of 1 N, preferably 15 mm or more from the upper edge of the sample. The penetration of the glow-wire into the sample is mechanically limited to 7 mm. After 30 s the sample is withdrawn from contact with the glow-wire tip.

Any flame or glowing of the sample shall extinguish within 30 s of withdrawing the glow-wire and any burning or molten drops shall not ignite a piece of tissue paper consisting of five layers, spread out horizontally 200 ± 5 mm below the sample.

The glow-wire temperature and heating current shall be constant for 1 min prior to commencing the test. Care shall be taken to ensure that heat radiation does not influence the sample during this period. The glow-wire tip temperature is measured by means of a sheathed fine-wire thermocouple constructed and calibrated as described in IS 11000 (Part 2/Sec 1).

NOTE — Precautions should be taken to safeguard the health of personal conducting test against risks of:

a) explosion or fire;

b) inhalation of smoke and/or toxic products; and

c) toxic residues.

4.8 Creepage Distance for Caps

4.8.1 The minimum creepage distance between contact pins and the metal parts (if any) of the cap shall be in accordance with the requirements given in relevant data sheets. Relevant cap standard sheet numbers are given in Table 1.

Table 1 Data Sheet References

(*Clauses* 4.3.2.2 *and* 4.8.1)

Cap Type (1)	Sheet Numbers Lamp Caps (2)	 Gauges (3)
2G7	7004-102	7006-102
2G11	7004-82	7006-82
G23	7004-69	7006-69
G24, GX24	7004-78	7006-78

4.8.2 Compliance is checked by measurement in the most onerous position.

4.9 Lamp Cap Temperature Rise

4.9.1 The lamp cap temperature rise above ambient temperature shall not exceed the relevant value given in Table E-2.

4.9.2 The test procedure is specified in Annex E. Conditions of compliance are given in **F-4**.

4.9.3 Where it can be shown that one lamp group produces the highest cap temperature rise for a given lamp family, only test on this one lamp group are necessary to show compliance of all identically capped lamps.

4.10 Radio Interference Suppression Capacitors

Lamps which contain integral means of starting and/or contain capacitors to suppress radio interference shall have capacitors which comply with the following requirements.

4.10.1 *Moisture Resistance*

The capacitor shall be resistance to moisture. Compliance is checked by following test.

Before humidity treatment, the capacitors shall be kept at an ambient temperature which does not differ from the temperature within the humidity test enclosure by more than $^{+4}_{-0}$°C for at least 4 h.

Immediately after the humidity treatment of 48 h in an atmosphere of 91 percent to 95 percent relative humidity and an ambient temperature between 25°C and 35°C maintained within limits of ±1°C, the capacitors shall be subjected to and satisfactorily withstand a dc voltage of 2 000 V without breakdown for 1 min.

The test voltage shall be applied across the terminations of the capacitor and initially shall not be more than half the prescribed voltage. It shall than be raised gradually to the full value.

4.10.2 *Resistance to Flame and Ignition*

The capacitor shall be resistance to flame and ignition. The compliance is checked by following test.

The capacitors are each subjected to a gradually increasing ac voltage until breakdown occurs. The voltage source used to this effect shall have a short-circuit power of approximately 1 kVA.

Thereafter, each capacitor shall be connected in series with inductive ballast, of a rated wattage suitable for operating the relevant lamps and operated for 5 min at the rated voltage of the ballast.

During this test, the capacitor shall not induce flame or cause ignition.

4.11 Information for Luminaries Design

See Annex G.

4.12 Information for Ballast Design

See Annex H.

5 ASSESSMENT

5.1 General

This clause specifies the method a manufacturer should use that his product conforms to this standard on the basis of whole production assessment, in association with his test records on finished products. This method can also be applied for certification purposes. **5.2**, **5.3** and **5.5** give details of assessment by means of the manufacturer's records.

Details of batch test procedure which can be used to make limited assessment of batches are given in **5.4** and **5.6**. Requirements for batch testing are included in order to enable the assessment of batches presumed to contain unsafe lamps. As some safety requirements cannot be checked by testing, and as there may be no previous knowledge of the manufacturers' quality, batch testing cannot be used for certification purposes nor in any way for an approval of the batch. Where a batch is found to be acceptable, a testing agency may only conclude that there is no reason to reject the batch on safety grounds.

5.2 Whole Production Assessment by Means of the Manufacturer's Records

5.2.1 The manufacturer shall show evidence that his products comply with the particular requirements of **5.3**. To this end, the manufacturer shall make available on request all the results of his finished product testing pertinent to the requirements of this standard.

5.2.2 The test results may be drawn from working records and, as such, may not be immediately available in collated form.

5.2.3 The assessment shall be based, in general as per the acceptance criteria of **5.3**. The certification authority shall have the right to visit the plant to examine the records and quality control procedures with respect to the finished products.

5.2.4 For certification purposes, the manufacturer shall declare a list of lamp families, groups and/or types which are within the scope of this standard. The certificate shall be taken to include all lamps so listed and made by the manufacturer. Notification of additions or deletions may be made at any time.

5.2.5 In presenting the test results, the manufacturer may combine results for different lamp families, groups and/or types, according to col 4 of Table 2.

The whole production assessment requires that the quality control procedures of a manufacturer shall satisfy recognized quality system requirements for final inspection. Within the framework of a quality system based also on in-process inspection and testing, the manufacturer may show compliance with some of the requirements of this standard by means of in-process inspection instead of finished product testing.

5.2.6 The manufacturer shall provide sufficient test records with respect to each clause as indicated in col 5 and 6 of Table 2.

5.2.7 The number of non-conformities in the manufacturer's records shall not contravene the limits shown in Table 3 or 4 relevant to the Acceptable Quality Level (AQL) values shown in col 7 of Table 2.

5.2.8 The period of review for assessment purposes need not be limited to a predetermined year, but, may consist of 12 consecutive calendar months immediately preceding the date of review.

5.2.9 A manufacturer who has met, but no longer meets, the specified criteria, shall not be disqualified from claiming compliance with this standard providing he can show that:

a) action has been taken to remedy the situation as soon as the trend was reasonably confirmed form his test records; and

Table 2 Grouping of Test Records — Sampling and Acceptable Quality Levels (AQL)

(*Clauses* 5.2.5, 5.2.6, 5.2.7, 5.2.11, 5.3, 5.5.1, 5.5.2 *and* 5.5.3)

Clause or Sub-clause	Test	Type of Test	Permitted Accumulation of Test Records Between Lamp Groups	Minimum Annual Sample per Accumulation		AQL[1] (%)
				For Lamps Made Most of the Year	For Lamps Made in Frequently	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
4.2.2 (a)	Marking — Legibility	Running	All families with the same method of marking	200	32	2.5
4.2.2 (b)	Marking — Durability	Periodic	All families with the same method of marking	50	20	2.5
4.3.1 (Annex A as appropriate)	Construction and assembly of cap to bulb (unused lamps)	Periodic or design	All families using the same method of attachment and same tube diameter	125 or use F-1	80	0.65 —
	Construction and assembly of cap to bulb (after heating test)	Design	All families using the same method of attachment and same tube diameter	Use F-1		—
4.3.2	Dimensional requirements for caps	Periodic	All families using the same method of attachment and same tube diameter	32	32	2.5
4.3.3.1	Cap pin connection	Periodic	By group and type	125	80	0.65
4.3.3.2 (where applicable)	Cap key configuration	Periodic	By group and type	125	80	0.65
4.4	Insulation resistance	Design	All families using the same cap	Use F-2		—
4.5	Electric strength	Design	All families using the same cap	Use F-2		—
4.6	Accidentally live part	100% Inspection	By group and type	—		—
4.7.2	Resistance to heat	Design	All families	Use F-3		—
4.7.4	Resistance to fire	Design	All families	Use F-3		—
4.8	Cap creepage distance	Design	All families	Use F-3		—
4.9	Cap temperature rise	Design	Lamps selected according to **4.9.3**	Use F-4		—
4.10	Capacitor test	Design	All families using the same capacitor	Use F-3		—

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[1] For the use of this term *see* IS 2500 (Part 1).

Table 3 Acceptance Numbers, AQL = 0.65 Percent

(*Clause* 5.2.7)

Number of Lamps in Manufacturers Records	Acceptance Number	Number of Lamps in Manufacturers Records	Qualifying Limit for Acceptance as Percentage of Lamps in Records
(1)	(2)	(1)	(2)
Up to 80	1	2 001	1.03
81 to 125	2	2 100	1.02
126 to 200	3	2 400	1.00
201 to 260	4	2 750	0.98
261 to 315	5	3 150	0.96
316 to 400	6	3 550	0.94
401 to 500	7	4 100	0.92
501 to 600	8	4 800	0.90
601 to 700	9	5 700	0.88
701 to 800	10	6 800	0.86
801 to 920	11	8 200	0.84
921 to 1 040	12	10 000	0.82
1 041 to 1 140	13	13 000	0.80
1 141 to 1 250	14	17 500	0.78
1 251 to 1 360	15	24 500	0.76
1 361 to 1 460	16	39 000	0.74
1 461 to 1 570	17	69 000	0.72
1 571 to 1 680	18	145 000	0.70
1 681 to 1 780	19	305 000	0.68
1 781 to 1 890	20	1 000 000	0.67
1 891 to 2 000	21		

Table 4 Acceptance Numbers, AQL = 2.5 Percent

(*Clause* 5.2.7)

Number of Lamps in Manufacturers Records (1)	Acceptance Number (2)	Number of Lamps in Manufacturers Records (1)	Qualifying Lmit for Acceptance as Percentage of Lamps in Records (2)
Up to 20	1	1 001	3.65
21 to 32	2	1 075	3.60
33 to 50	3	1 150	3.55
51 to 65	4	1 250	3.50
66 to 80	5	1 350	3.45
81 to 100	6	1 525	3.40
101 to 125	7	1 700	3.35
126 to 145	8	1 925	3.30
146 to 170	9	2 200	3.25
171 to 200	10	2 525	3.20
201 to 225	11	2 950	3.15
226 to 255	12	3 600	3.10
256 to 285	13	4 250	3.05
286 to 315	14	5 250	3.00
316 to 335	15	6 400	2.95
336 to 360	16	8 200	2.90
361 to 390	17	11 000	2.85
391 to 420	18	15 500	2.80
421 to 445	19	22 000	2.75
446 to 475	20	34 000	2.70
476 to 500	21	60 000	2.65
501 to 535	22	110 000	2.60
536 to 560	23	500 000	2.55
561 to 590	24	1 000 000	2.54
591 to 620	25		
621 to 650	26		
651 to 680	27		
681 to 710	28		
711 to 745	29		
746 to 775	30		
776 to 805	31		
806 to 845	32		
846 to 880	33		
881 to 915	34		
916 to 955	35		
956 to 1 000	36		

b) the specified acceptance level was re-established within a period of:
   1) 6 months for **4.3.1** and **4.9**, and
   2) 1 month for other clauses.

When compliance is assessed after corrective action has been taken in accordance with items (a) and (b), the test records of these families, groups and/or types which do not comply shall be excluded from the 12-month summation for their period of non-compliance. The test results relating to the period of corrective action shall be retained in the records.

5.2.10 A manufacturer who has failed to meet the requirements of a clause where grouping of the test results is permitted under **5.2.5** shall not be disqualified for the whole of the lamp families, groups and/or types so grouped if he can show by additional testing that the problem is present only in certain families, groups and/or types so grouped. In this case, either these families, groups and/or types are dealt with in accordance with **5.2.9** or they are deleted from the list of families, groups and/or types, which the manufacturer may claim are in conformity with the standard.

5.2.11 In the case of a family, group and/or type which has been deleted under **5.2.10** from the list (*see* **5.2.4**), it may be reinstated, if satisfactory results are obtained from tests on a number of lamps equivalent to the minimum annual sample specified in Table 2, required by the clause or sub-clause where non-compliance occurred. This sample may be collected over a short period of time.

5.2.12 In the case of new products, there may be features which are common to existing lamp families, groups and/or types, and these can be taken as being in compliance, if the new product is taken into the sampling scheme as soon as manufacture is started. Any feature not so covered shall be tested before production starts.

5.3 Assessment of the Manufacturer's Records of Particular Test

Table 2 specifies the type and other information which applies to the method of assessing compliance to the requirement of various clauses.

A design test need be repeated only when a substantial change is made in the physical or mechanical construction, materials, or manufacturing process used to manufacture the relevant product. Tests are required for only those properties affected by the change.

5.4 Rejection Conditions of Batches

Rejection is established if any rejection number in Table 5 with due regard to Annex F is reached irrespective of the quantity tested. A batch shall be rejected as soon as the rejection number for a particular test is reached.

5.5 Sampling Procedures for Whole Production Testing

5.5.1 The conditions of Table 2 shall apply.

5.5.2 The whole production running test shall be applied at least once per production day. They may also be based on in-process inspection and testing.

The frequency of application of the various periodic tests may be different, providing the conditions of Table 2 are met.

5.5.3 Whole production test shall be made on samples randomly selected at a rate not less than that indicated in col 5 of Table 2. Lamps selected for one test need not to be used for other tests.

5.5.4 For whole production testing of the requirements for accidentally live parts (*see* **4.6**), the manufacturer shall demonstrate that there is a continuous 100 percent inspection.

5.6 Sampling Procedure for Batch Testing

5.6.1 The lamps for testing shall be selected in accordance with a mutually agreed method so as to ensure proper representation. Selection shall be randomly made as nearly as possible from one-third of the total number of containers in the batch, with a minimum of ten containers.

5.6.2 In order to cover the risk of accidental breakage, a certain number of lamps, in addition to the test quantity shall be selected. These lamps shall only be substituted for lamps of the test quantity if necessary to make up the required quantity of lamps for the tests.

It is not necessary to replace an accidentally broken lamp if the results of the test are not affected by its replacement, provided the required quantity of lamps for the following test is available. If replaced, such a broken lamp shall be neglected in calculating results.

Lamps having broken bulbs when removed from the packaging after transit shall not be included in the test.

5.6.3 *Number of Lamps in the Batch Sample*

There shall be at least 500 lamps (*see* Table 5).

5.6.4 *Sequence of the Tests*

The testing shall be carried out in the order of the clause numbers listed in Table 5, up to and including **4.6**. Subsequent tests may involve damage to the lamp and each test sample shall be taken separately from the original sample.

Table 5 Sample Size and Rejection Number

(*Clauses* 5.4, 5.6.3 *and* 5.6.4)

Clause or Sub-clause (1)	Test (2)	Number of Lamps Tested (3)	Rejection Number (4)
4.2.2 (a)	Marking — Legibility	200	11
4.2.2 (b)	Marking — Durability	50	4
4.3.1	Construction and assembly for caps (unused lamps)	125 Or apply F-1 as relevant	3
4.3.2.2	Dimensional requirements for caps	32	3
4.3.3.1	Pin connection	125	3
4.3.3.2	Key configuration	125	3
4.4	Insulation resistance	Apply F-2	
4.5	Electric strength	Apply F-2	
4.6	Accidentally live part	500	1
4.3.1	Construction and assembly for caps (after heating)	Apply F-1	
4.7.2	Resistance to heat	Apply F-3	
4.7.4	Resistance to Fire	Apply F-3	
4.8	Cap creepage distance	Apply F-3	
4.9	Cap temperature rise	Test not applicable	
4.10	Radio interference suppression capacitors	Apply F-3	

ANNEX A

(*Clause* 4.3.1)

TESTS FOR ASSESSING CAPS FOR CONSTRUCTION AND ASSEMBLY

A-1 FOR UNUSED LAMPS

Compliance is checked by the following periodic tests.

Neither lamp bulb nor lamp cap shall be loosened by an axial pull of 40 N or a bending moment of 3 Nm. The bending shall be applied by holding in a uniform manner that part of the glass tube closest to the cap. The pivot point lies at the cap reference plane (mating plane with the lamp holder). The pulling force and bending moment shall not be applied suddenly but shall be increased gradually from zero to the specified value.

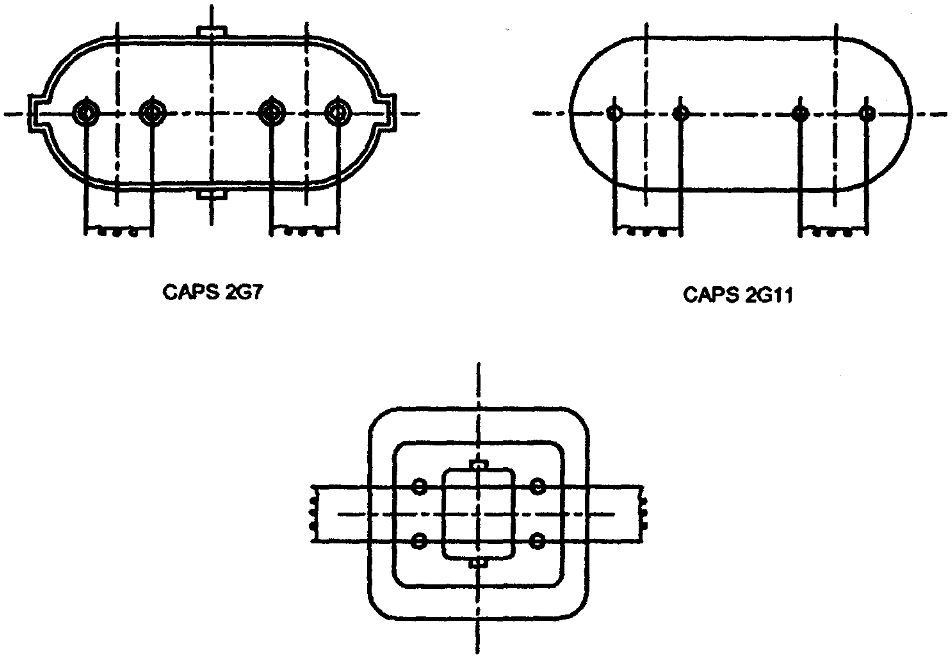
A-2 FOR LAMPS AFTER HEATING TEST

After heating lamps for a period of 2 000 ± 50 h in an oven held at a temperature as specified in Annex G, caps shall withstand pulling forces and bending moment which are under consideration. For condition of compliance, *see* **H-1**.

ANNEX B

(*Clause* 4.3.3.1)

CATHODE CONNECTION CONFIGURATIONS



CAPS 2G7

CAPS 2G11

CAPS G24q, GX24q

FIG. B-1 CATHODE CONNECTION CONFIGURATIONS

ANNEX C

(*Clause* 4.3.3.2)

LAMP NON-INTERCHANGEABILITY REQUIREMENTS

For lamps using either an internal or external starter, the most onerous situation with regard to cap temperature occurs when the pre-heat current flow continuously through the lamp electrodes. This can happen at the end of lamp life when the lamp does not start.

Therefore, a lamp shall not be connected to ballast having a maximum pre-heat current which results in a higher temperature than the cap of the lamp can withstand. For some types of lamp caps, it is necessary to introduce a non-interchangeability feature which prevents the incorrect installation of different lamp using similar cap types into the luminaire circuit.

For certain lamps, such a feature has been introduced by means of different cap/holder keys, and Table C-1 gives the relationship between a specific cap/holder designation and the allowable maximum pre-heat current.

Also shown in Table C-1 are cap types which do not have a keying feature because no existing lamp/circuits combination exceeds the maximum allowable pre-heat current.

To ensure that an unsafe condition cannot occur in the future due to the introduction of lamps and/or circuits with higher pre-heat current, the limiting maximum pre-heat currents are also specified in Table C-1.

This relationship shall be observed for all new lamp designs utilizing these cap/holder designations.

Table C-1 Maximum Allowable Pre-heat Currents

Cap/Holder (Designation Key) (1)	Maximum Pre-heat Current[1] A (2)
2G7, G23	0.240
2G11	0.780
G24-1, GX24-1	0.280
G24-2, GX24-2	0.380
G24-3, GX24-3	0.550

NOTE — It is essential that any new key configuration be standardized.

---

[1] Under consideration.

ANNEX D

(*Clauses* 4.7.2.1, 4.7.2.2 *and* A-2.2)

INFORMATION FOR THERMAL TESTS

Table D-1 Tests Temperature

Cap Designation (1)	Lamp Nominal Wattage W (2)	Temperature[1] °C (3)
G23, G24, GX24	All	160
2G7, 2G11	All	160

---

[1] Under consideration.

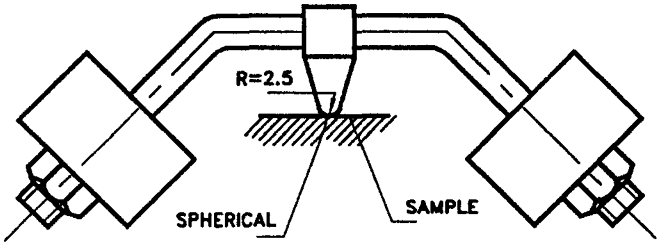


FIG. D-1 BALL PRESSURE APPARATUS

ANNEX E

(*Clauses* 4.9.1 *and* 4.9.2)

MAXIMUM LAMP CAP TEMPERATURE RISE VALUES AND METHODS OF MEASUREMENT

E-1 GENERAL TEST CONDITIONS

E-1.1 The lamp shall be operated in a draught free atmosphere at an ambient temperature of 25 ± 5°C, suspended in a low mass nylon slings with the cap pins facing vertically upwards.

E-1.2 The lamp shall be a normal production lamp but specially produced such that its cathode are de-activated, that is without cathode emitter.

E-1.3 Electrical connections to the lamps shall be made with copper conductors having a cross-sectional area of 1 mm^2 ± 5 percent, attached to the relevant cap pins.

E-1.4 The lamp shall be operated with its relevant reference ballast which shall be supplied with 1.10 times its rated voltage.

E-1.5 The starter shall be short circuited that is the cathode shall be operated in series.

E-1.6 The test shall continue until a stable temperature is achieved.

E-1.7 Where necessary, the surface of caps shall be suitably prepared to give good contact with the temperature. Measuring device (for example, thermocouples).

E-2 PARTICULAR TEST CONDITIONS

E-2.1 The temperature rise shall be measured at the hottest point on the cap surface at a distance *X* from the reference plane of the cap, as indicated in Table E-1 and E-2, in the direction of glass limbs.

Table E-1 Distance *X* for Different Types of Caps

Cap Designation (1)	Distance *X*, mm (2)
2G7	8[1]
2G11	12[1]
G23	8
G24	12[1]

---

[1] Under consideration.

Table E-2 Maximum Cap Temperature Rise
(*Clauses* 4.9.1, G-2 *and* F-4)

Cap Designation (1)	Lamp Nominal Wattage W (2)	Maximum Cap Temperature Rise K (3)
2G7	All	75
2G11	All	75
G23	All	75
G24	All	75
GX24	All	75

ANNEX F

(*Clauses* 4.9.2, 5.4 *and* A-2.2)

CONDITIONS OF COMPLIANCE FOR DESIGN TESTS

F-1 CAP CONSTRUCTION AND ASSEMBLY (*See* 4.3.1)

Sample size: 32	Rejection number: 2

F-2 INSULATION RESISTANCE AND ELECTRIC STRENGTH (*See* 4.4 and 4.5)

Each test shall be assessed separately,

First sample: 125	Rejection number: 2
If one failure is found, take a second sample of 125	Rejection number: 2 in the combined sample

F-3 RESISTANCE TO HEAT (*See* 4.7.2), RESISTANCE TO FIRE (*See* 4.7.4), CAP CREEPAGE DISTANCE (*See* 4.8), CAPACITOR TEST (*See* 4.10)

Each test shall be assessed separately,

First sample: 5	Accept when no failure has been found Rejection number: 2
If one failure is found, take a second sample of 5	Rejection number: 2 in the combined sample

F-4 CAP TEMPERATURE RISE (*See* 4.9)

First sample: 5	Accept if all sample have a temperature rise of at least 5 K below limit	In other cases, take a second sample of 5	Rejection number: 2 in the combined sample with a cap temperature rise that exceeds the limit in Table E-2 in the combined sample

ANNEX G

(*Clause* 4.11)

INFORMATION FOR LUMINAIRE DESIGN

G-1 GUIDELINES FOR SAFE LAMP OPERATION

To ensure safe lamp operation, it is essential to observe the following recommendations.

G-2 MAXIMUM LAMP CAP TEMPERATURE UNDER ABNORMAL OPERATING CONDITIONS

The luminaire designer shall ensure that the cap temperature of the lamp, under abnormal conditions, does not exceed the maximum cap temperature value shown in Table G-1.

Luminaires shall be tested using the intended lamp with the starter short-circuited, that is the cathodes operated in series.

The measuring point is given in **E-2**.

Compliance is checked in accordance with the relevant test specified in IS 10322 (Part 1).

Table G-1 Maximum Cap Temperature

Cap Designation (1)	Lamp Nominal Wattage (2)	Maximum Cap Temperature[1] (3)
G23, G24 and GX24	All	140
2G7 and 2G11	All	140

---

[1] Under consideration.

G-3 CAP/HOLDER-KEY CONFIGURATION

The luminaire designer shall ensure that, if applicable, a holder with the correct key version for the intended lamp/ballast combination is installed in the luminaire.

Compliance is checked by visual inspection.

ANNEX H

(*Clause* 4.12)

INFORMATION FOR BALLAST DESIGN

H-1 GUIDELINES FOR SAFE LAMP OPERATION

To keep safe lamp operation, it is essential to observe the following recommendations.

H-2 LAMP END TEMPERATURE UNDER ABNORMAL OPERATING CONDITIONS

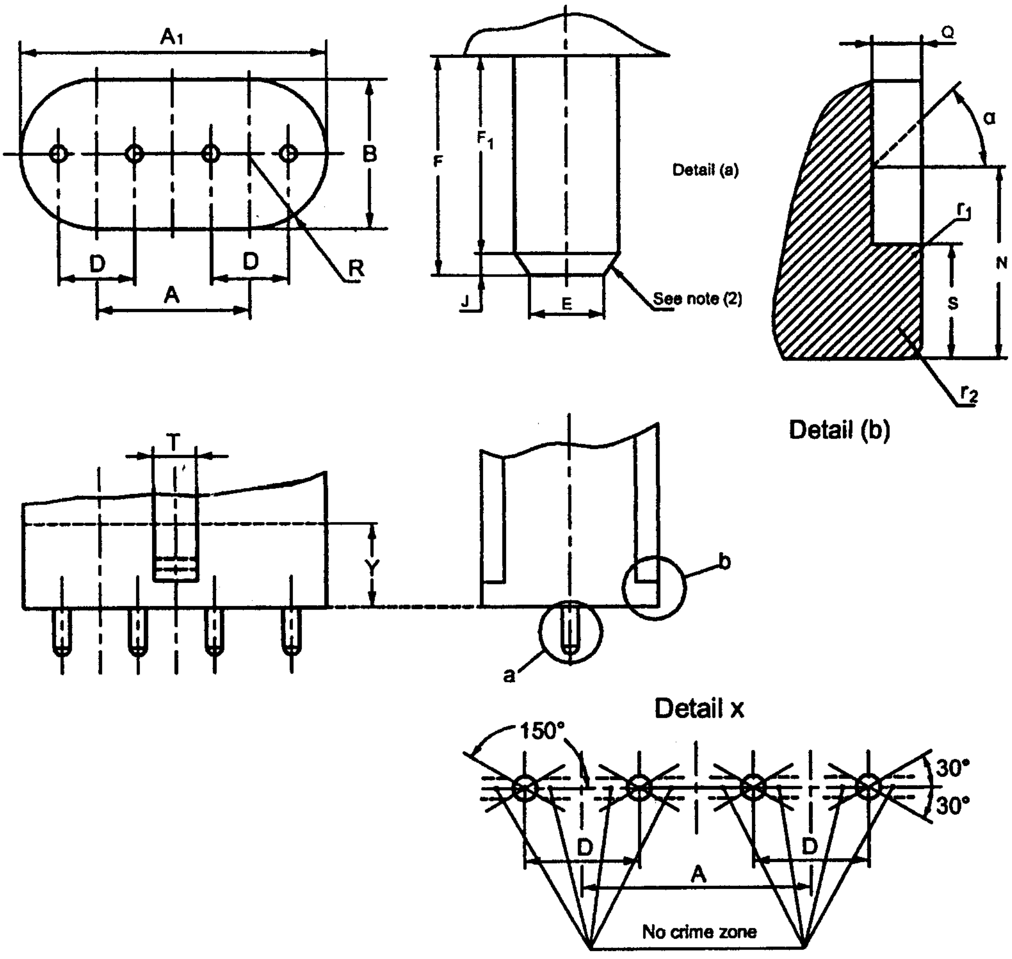
In the case where a lamp does not start, any continuation of cathode preheating should not lead to overheating of the lamp ends.

In the case where one of the cathodes is depleted or broken, while the lamp continues to operate (partial rectification), overheating of the lamp ends should be prevented by suitable measures in the circuit.

CAP
2G11

Dimensions in millimetres.

The drawings are intended only to indicate the dimensions essential for interchangeability.



See note (6)

Dimension	Min		Max
A (7)		22	
A$_1$*	43.3		43.9
*B**	23.2		23.6
D		11	
E (3)	2.29		2.67
F	6.0		6.8
F$_1$	5.5		—
*J**	0.4		—
N (4)*	6.5		—
Q (4) (5)*	1.5		—
R		B/2	
S (4) (5)*	3.5		3.9
*T**	7.0		—
Y (1)*	12.7		—
r$_1$ (5)*	0.3		0.5
r$_2$ (5)*	0.2		0.5
α (4) (5)*		45°	

---

* These dimensions are solely for cap design and are not to be gauged on the finished lamp.

NOTES

1 Dimension Y denotes the minimum length over which the maximum limit of dimensions A_1, B and R shall be observed.

2 Edges slightly chamfered or rounded.

3 For unmounted caps $E_{Max} = 2.44$ mm.

4 Dimensions N, S and α define the minimum length of the notch over which dimensions Q and T apply. The maximum length of the notch is not specified and the notch may run up to the top of the cap.

5 Dimensions Q, S, r_1, $r_{2\,Min}$ and α apply within the width of the notch, dimension T. Outside dimension T, only the limit for dimension $r_{2\,Max}$ applies.

6 Indentations or grooves in the surface of the pins are allowed provided they do not extend into that part of the pin radius which is bounded by angles of 30° and 150° to the plane through the centerlines of the pins (see detail x). The diameter of the pins measured in the no crimp zone along the length of the pin shall not be less than 2.29 mm.

7 Dimension A denotes the centerline spacing of the two pairs of pins.

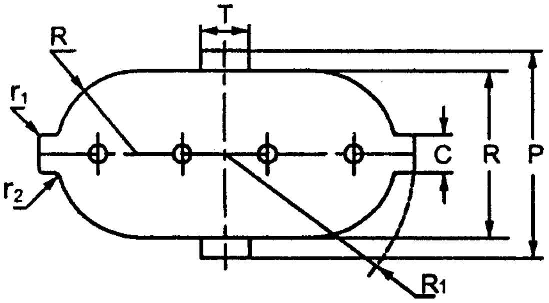
GAUGING — 2G11 caps on finished lamps shall fulfill the tests of the gauge shown on Data Sheet **7006-82.**

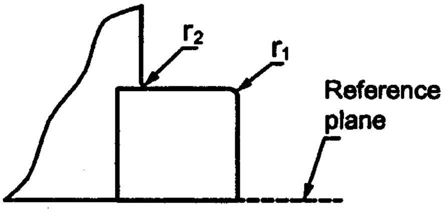
7004-82-1

CAP
2G7

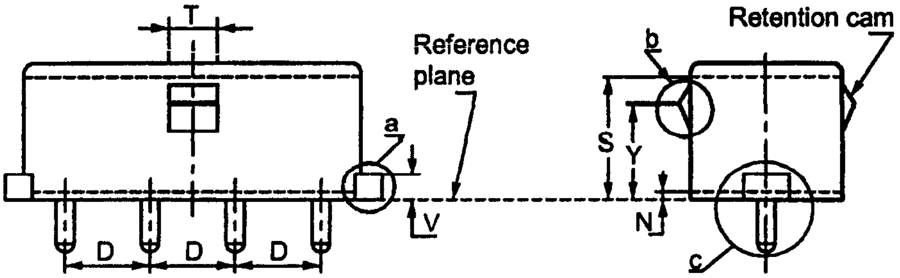
Dimensions in millimetres.

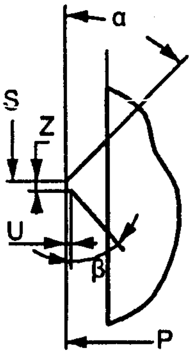
The drawings are intended only to indicate the dimensions essential for interchangeability.



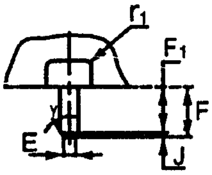


Detail (a)

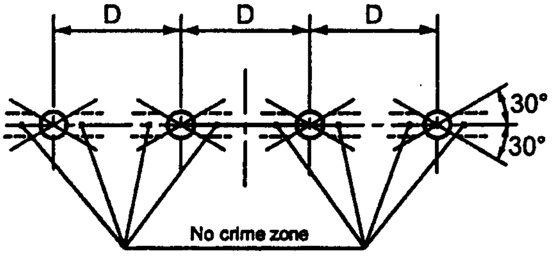




Detail (b)



Detail (c)



Detail (x)

Dimension	Min		Max	Dimension	Min	Max
A (1)	31.5		32.5	S	10.75	11.25
B (1)	17.7		18.1	T	3.5	4.5
C	5.0		6.0	U*	—	0.2
D (5)		7.0		V	3.5	4.0
E (3) (5)	2.29		2.67(2)	W	36.5	37.5
F (5)	6.0		6.8	Y (1)	14.0	—
F_1	5.5		—	Z*	0.5	—
J	0.4		—	r_1 (4)	—	0.4
N (1)		1.5		r_2	—	0.1
P	20.6		21.0	α	Nom 35°	
R		$B/2$		β	20°	30°
R_1		$W/2$		γ	Approx 30°	

---

* These dimensions are solely for cap design and are not to be gauged on the finished lamp.

NOTES

1 Dimension Y denotes the minimum length over which the minimum and maximum limits of dimensions A and B shall be observed.

Local recesses are allowed provided that they do not influence the side-way stability of the lamp in the holder.

Below dimension Y (dimension N) only the maximum limits for dimensions A and B apply.

2 For unmounted caps $E_{\text{Max}} = 2.44$ mm.

3 Indentations or grooves in the surface of the pins are allowed provided that they do not extend into that part of the pin radius which is bounded by angles of 30° to the plane through the centre lines of the pins (see detail x). The diameter of the pins measured in the direction perpendicular to these planes through the centre lines shall be not less than 2.29 mm in every plane parallel to the cap face.

4 A chamfer of approx 0.4 mm is allowed.

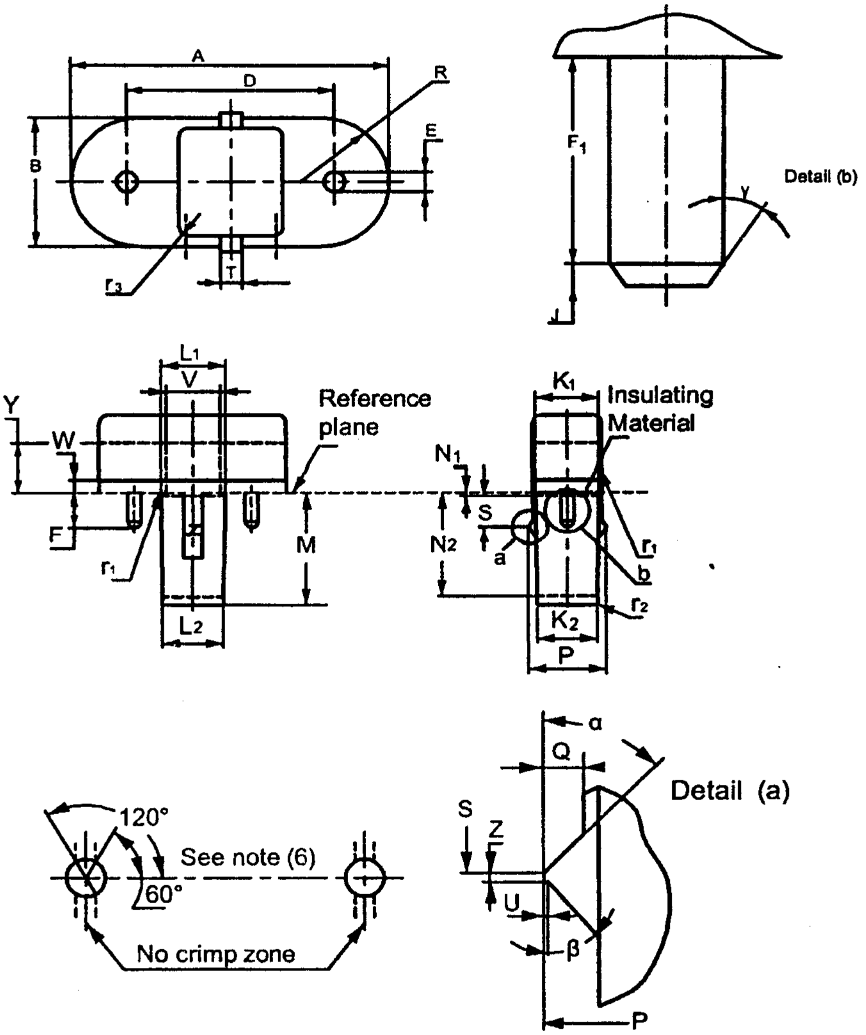
5 The combined displacement and the diameter of the pins, the minimum and maximum diameter of the individual pins and the minimum and maximum pin length are checked by the "Go" and "Not Go" gauge for caps 2G7 on finished lamps shown on Data Sheet 7006-102.

7004-102-1

B1-PIN CAP
G23

Dimensions in millimetres.

The drawings are intended only to indicate the dimensions essential for interchangeability.



Dimension	*Min*	*Max*	*Dimension*	*Min*	*Max*
A (2)	31.5	32.5	*Q*	1.2	—
B (1) (2)	17.7	18.1	*R* (2)	—	9.05
D (9)	23.0		*S*	8.85	9.15
E (6) (9)	2.29	*T* (1) (9)	*T* (1) (9)	3.5	4.5
F (9)	6.0	6.8	*U**	—	0.2
F$_1$	5.5	—	*V* (1)	11	
J	0.4	—	*W* (1) (8)	3.0	—
K$_1$ (4) (9)	16.15	16.3	*Y* (2)	10.2	—
K$_2$ (5)	15.6	15.75	*Z**	0.5	—
L$_1$ (4) (9)	13.75	13.9	r_1	—	0.4
L$_2$ (5)	13.2	13.35	r_2* (7)	Approx 0.8	
M	—	23.0	r_3	0.5	1.0
N$_1$ (4)	0.5		α*	Nom 35°	
N$_2$ (5)	21.0		β	20°	30°
P (9)	20.6	21.0	γ	Approx 30°	

---

* These dimensions are solely for cap design and are not to be gauged on the finished lamp.

NOTES

1 Dimension B minimum applies outside dimension T up to at lest dimension V and up to dimension W minimum. Dimension B maximum applies outside dimension T.

2 Dimension Y denotes the minimum length over which the maximum limits of dimensions. A, B and R shall be observed.

3 On unmounted cap E_{Max} = 2.44

4 Dimensions K_1 and L_1 are measured at distance N_1 from the reference plane.

5 Dimensions K_2 and L_2 are measured at distance N_2 from the reference plane.

6 Indentations or grooves in the surface of the pins are allowed provided that they do not extend into that part of the pin-radius which is bounded by the angles of 60° and 120° to the plane through the centrelines of the pins (see drawing). The diameter of the pins measured in the direction perpendicular to the plane through the centrelines of the pins shall be not less than 2.29 mm in every plane parallel to the cap face.

7 A chamfer of approx 0.8 mm is also allowed.

8 Dimension W denotes the height of the insulating part.

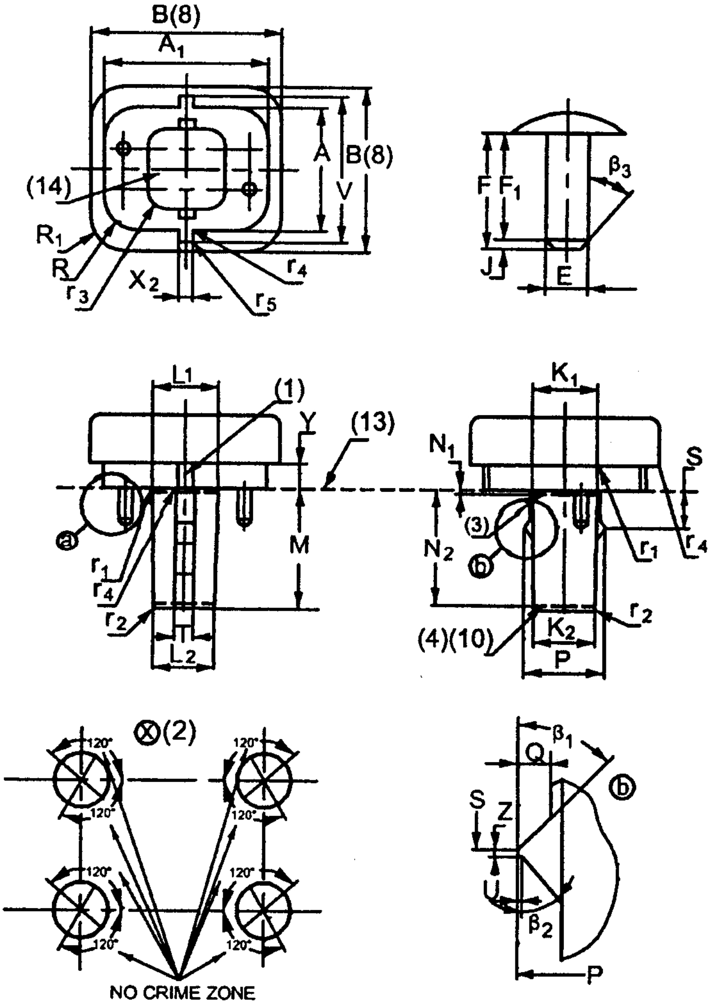
9 The combined displacement and the diameter of the pins, the minimum and the maximum diameter of the individual pins, the minimum and maximum pin length and the maximum values of dimensions K_1, L_2, P and T checked by the gauge shown on Data Sheet 7006-69.

7004-69-1

CAPS
G24 and GX24

Dimensions in millimetres.

The drawings are intended only to indicate the dimensions essential for interchangeability.



Only the G24d-1 cap is shown in the above figure. For caps with different designations, see page 2 of this data sheet.

DESIGN TYPES

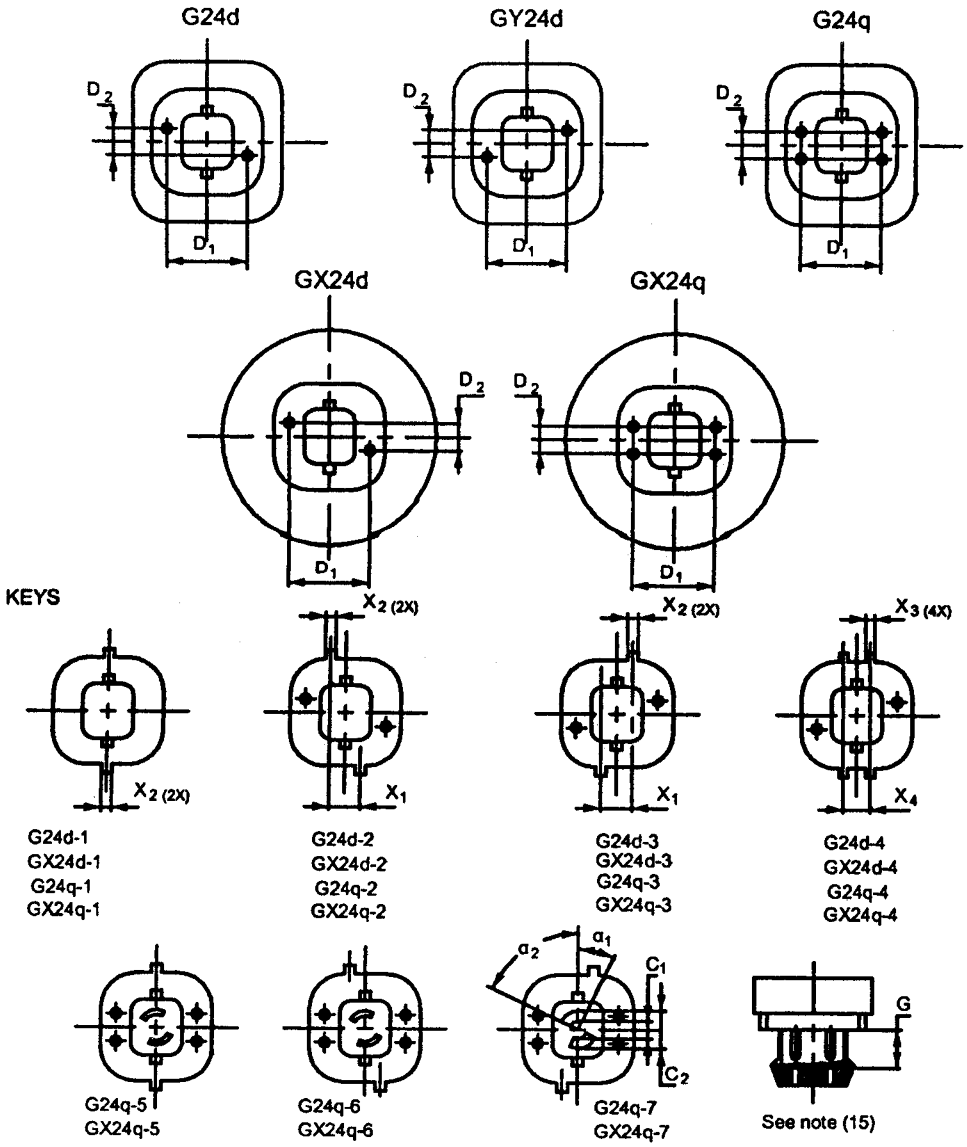
KEYS

G24d-1	G24d-2	G24d-3	G24d-4
GX24d-1	GX24d-2	GX24d-3	GX24d-4
G24q-1	G24q-2	G24q-3	G24q-4
GX24q-1	GX24q-2	GX24q-3	GX24q-4
G24q-5	G24q-6	G24q-7	See note (15)
GX24q-5	GX24q-6	GX24q-7	

NOTE — Outer keys have the same position and size as the ones shown just above.

CAPS
G24 and GX24

Dimensions in millimetres.



<table>
<tr><th><i>Dimension</i></th><th><i>Min</i></th><th><i>Max</i></th><th><i>Dimension</i></th><th><i>Min</i></th><th><i>Max</i></th></tr>
<tr><td>A (6)</td><td>27.5</td><td>28.5</td><td>R_1</td><td>9.0</td><td>—</td></tr>
<tr><td>A_1 (6)</td><td>27.5</td><td>31.0</td><td>S</td><td>8.85</td><td>9.15</td></tr>
<tr><td>B</td><td>—</td><td>35.0(8)</td><td>T</td><td>3.5</td><td>4.5</td></tr>
<tr><td>C_1 (14)</td><td>—</td><td>6.5</td><td>U*</td><td>—</td><td>0.2</td></tr>
<tr><td>C_2 (14)</td><td>10.1</td><td>—</td><td>V</td><td>32.0</td><td>33.0</td></tr>
<tr><td>D_1</td><td colspan="2">23.0</td><td>X_1</td><td colspan="2">9.3</td></tr>
<tr><td>D_2</td><td colspan="2">8.0</td><td>X_2</td><td>2.5</td><td>—</td></tr>
<tr><td>E (2)</td><td>2.29</td><td>2.67(7)</td><td>X_3</td><td>1.5</td><td>—</td></tr>
<tr><td>F</td><td>6.0</td><td>6.8</td><td>X_4</td><td colspan="2">7.5</td></tr>
<tr><td>F_1</td><td>5.5</td><td>—</td><td>Y (6)</td><td>5.7</td><td>—</td></tr>
<tr><td>G (15)</td><td colspan="2">8.6</td><td>Z*</td><td>0.5</td><td>—</td></tr>
<tr><td>J</td><td>0.4</td><td>r_1</td><td>r_1</td><td>—</td><td>0.4</td></tr>
</table>

Dimension	*Min*	*Max*	*Dimension*	*Min*	*Max*
K_1 (3)	16.15	16.3	r_2* (5)	Approx 0.8	
K_2 (4)	15.6	15.75 (11)	r_3	0.5	1.5
L_1 (3)	13.75	13.9	r_4	—	0.2
L_2 (4)	13.2	13.35 (12)	r_5	0.2	0.5
M	—	23.0 (9)	α_1 (14)	25°	—
N_1 (3)	0.5		α_2 (14)	65°	—
N_2 (4) (10)	21.0		β_1*	Nom 35°	
P	20.6	21.0	β_2	20°	30°
Q	1.2	—	β_3	Approx 30°	
R (6)	8.4	9.5			

NOTES

1 Key. In the design of keys –1 and –5, the keys are located on the centreline.

2 Indentations or grooves in the surface of the pins are allowed provided that they do not extend into that part of the pin-radius which is bounded by the angled of 120° to the two parallel planes separated by dimension D_2 (see detail x). The diameter of the pins measured in the direction perpendicular to these planes through the centrelines shall be not less than 2.29 mm in every plane parallel to the base face.

3 Dimensions K_1 and L_1 are measured at distance N_1 from the reference plane.

4 Dimensions K_2 and L_2 are measured at distance N_1 from the reference plane.

5 A chamfer of approximately 0.8 mm is also allowed.

6 With the exception of the keys, the circumference of the cap, within dimension Y, shall lie between the limits determined by the dimensions A_{Max}, $A_{1\,Max}$ and R_{Min}, on the one side and A_{Min}, $A_{1\,Min}$ and R_{Max} on the other.

7 On unmounted caps $E_{Max} = 2.44$ mm.

8 Modified fits, where the outline defined by dimension B is replaced by a circular outline with a maximum diameter of 61 mm are designated GX24d-, and GX24q-.

9 For caps G24q- and GX24q- this value is reduced to 16 mm.

10 For caps G24q- and GX24q- this value is reduced to 14 mm.

11 For caps G24q- and GX24q- this value is increased to 15.95 mm.

12 For caps G24q- and GX24q- this value is reduced to 13.55 mm.

13 Reference plane.

14 To prevent mis-insertion, the bottom of the centre-posts of caps with keys –1, –2, –3 and –4 shall be closed inside at least the area as defined by dimensions C_1, C_2, α_1 and α_2.

15 Free space. Applies to caps with –5, –6 and –7 only.

GAUGING — The combined displacement and diameter of the pins, the combined displacement and width of the keys, the maximum values of dimensions K_1, L_1, P and T, the minimum and maximum diameter of the individual pins and the minimum and maximum pin lengths are checked by the related gauge shown on sheet **7006-78.**

---

* These dimensions are solely for cap design and are not to be gauged on the finished lamp.

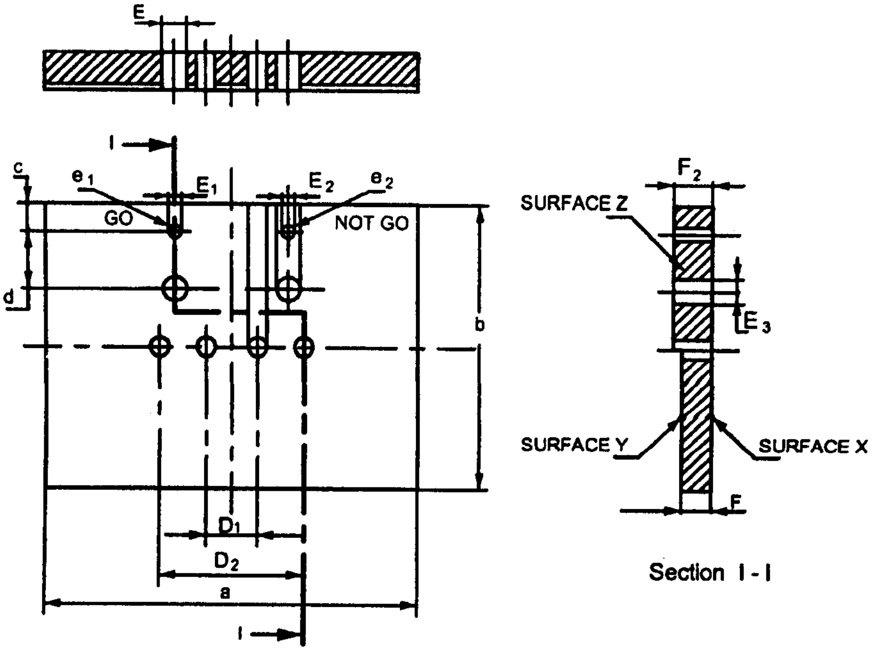
"GO" AND "NOT GO" GAUGE FOR CAPS ON FINISHED LAMPS

2G7

Dimensions in millimetres.

The drawing is intended only to illustrate the essential dimensions of the gauge.

For details of cap 2G7, *see* Data Sheet **7004-102.**



Section I - I

Reference	*Dimension*	*Tolerance*	*Reference*	*Dimension*	*Tolerance*
D_1	7.0	+ 0.005 – 0.005	F	6.0	+ 0.0 – 0.025
D_2	21.0	+ 0.005 – 0.005	F_2	6.8	+ 0.025 – 0.0
E	2.79	+ 0.01 – 0.0	a	60	+ 0.5 – 0.5
E_1	2.67	+ 0.01 – 0.0	b	40	+ 0.5 – 0.5
E_2	2.29	+ 0.0 – 0.01	c	5	+ 0.0 – 0.2
E_3	3.5	+ 0.2 – 0.0	d	7.0	+ 0.1 – 0.1

PURPOSE — To check dimensions E_{Min}, E_{Max}, F_{Min}, F_{Max} and the combined diameter and displacement of the pins of caps 2G7 on finished lamps.

TESTING — The cap shall enter the gauge at surface *X* and when fully inserted, the reference plane of the cap and surface *X* of the gauge shall contact. In this position the ends of the pins shall be co-planar with or project beyond surface *Z*.

It shall be possible to insert each pin in turn into hole or until the reference plane of the cap and the surface of the gauge contact.

It shall not be possible to insert the pins, other than the extreme tips, into hole e_2.

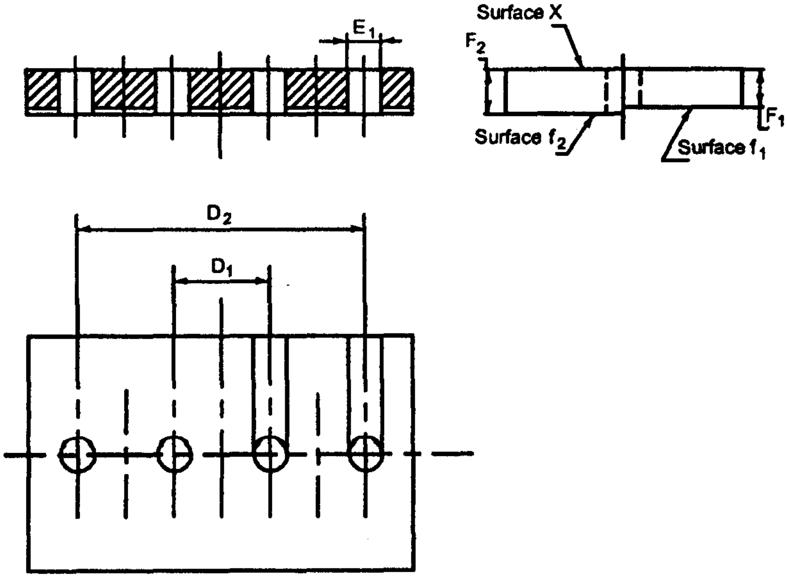
7006-102-1

"GO" GAUGE FOR CAPS ON FINISHED LAMPS
2G11

Dimensions in millimetres.

The drawing is intended only to illustrate the essential dimensions of the gauge.

For details of cap 2G11, *see* Data Sheet **7004-82**.



Reference	*Dimension*	*Tolerance*
D_1	11	+ 0.005 − 0.005
D_2	33	+ 0.005 − 0.005
E_1	2.9	+ 0.01 − 0.0
F_1	6.0	+ 0.0 − 0.025
F_2	6.8	+ 0.025 − 0.0

PURPOSE — To check 2G11 caps on finished lamps for combined spacing, displacement, diameter and length of pins.

TESTING — It shall be possible to insert the cap into the gauge until the reference plane of the cap is in contact with surface *X* of the gauge.

In this position, the ends of all pins shall be co-planar with or project beyond surface f_1 but shall not project beyond surface f_2.

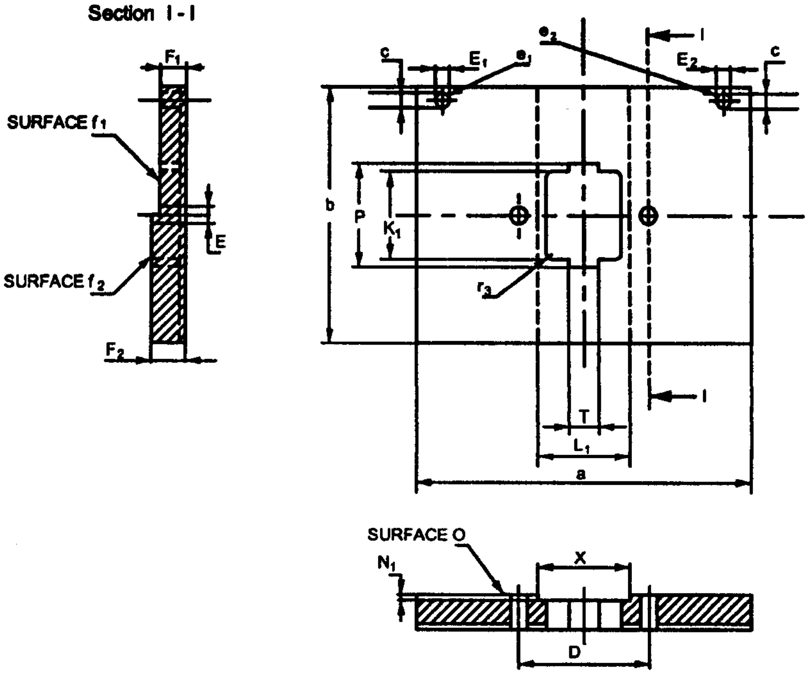
"GO" AND "NOT GO" GAUGE FOR BI-PIN CAPS ON FINISHED LAMPS

G23

Dimensions in millimetres.

The drawing is intended only to illustrate the dimensions essential for interchangeability.

For details of bi-pin cap G23, *see* Data Sheet 7004-69.



Reference	*Dimension*	*Tolerance*	*Reference*	*Dimension*	*Tolerance*
D	23.0	+ 0.005 − 0.005	N_1	0.5	+ 0.01 − 0.0
E	2.79	+ 0.01 − 0.0	P	21.0	+ 0.01 − 0.0
E_1	2.67	+ 0.01 − 0.0	T	4.7	+ 0.01 − 0.0
E_2	2.29	+ 0.0 − 0.01	X	16. 0	+ 0.1 − 0.1
F_1	6.0	+ 0.0 − 0.025	a	60	+ 0.5 − 0.5
F_2	6.8	+ 0.025 − 0.0	b	40	+ 0.5 − 0.5
K_1	16.3	+ 0.01 − 0.0	c	3	+ 0.0 − 0.2
L_1	13.9	+ 0.01 − 0.0	r_3	0.5	+ 0.0 − 0.05

PURPOSE — To check dimensions $K_{1\,\mathrm{Max}}$, $L_{1\,\mathrm{Max}}$, $L_{1\,\mathrm{Max}}$, P_{Max}, T_{Max}, $r_{3\,\mathrm{Min}}$, F_{Min}, F_{Max}, E_{Min}, E_{Max} and the combined diameter and displacement of the pins of bi-pin caps G23 on finished lamps.

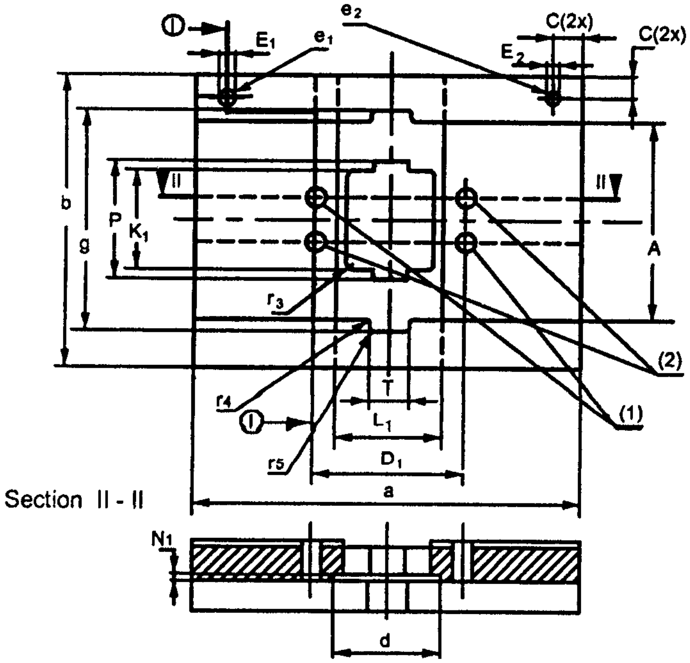
TESTING — The centre post and the pins of the cap shall enter the gauge at surface O and when fully inserted, the reference plans of the cap and the surface of the gauge shall contact. In this position the ends of the pins shall be co-planar with or project beyond surface f_1 but they shall not project beyond surface f_2. It shall be possible to insert each pin in turn into hole e_1 until the reference plane of the cap and the surface of the gauge contact. It shall not be possible to insert the pins, other than the extreme tips into hole e_2.

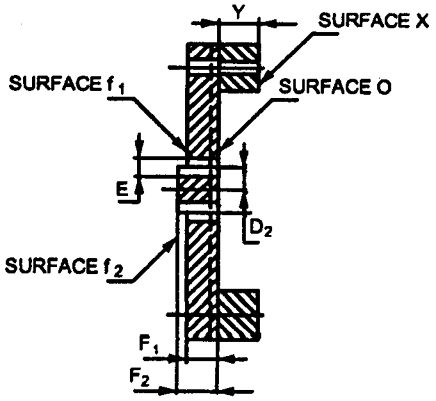
"GO" AND "NOT GO" GAUGE FOR CAPS
G24 and GX24

Dimensions in millimetres.

The drawing is intended only to illustrate the dimensions essential for interchangeability.

For details of caps G24 and GX24, *see* Data Sheet **7004-78**.





Section I - I

SPECIFIC GAUGE DESIGN

Views at surface *X* and *O*

Key hole configuration for checking G24d-, GX24d-, G24q-, and GX24q-, caps respectively.

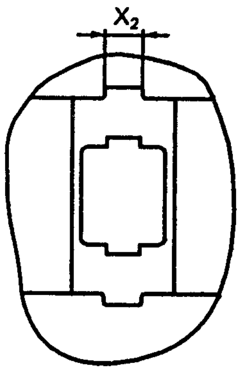


Figure 1

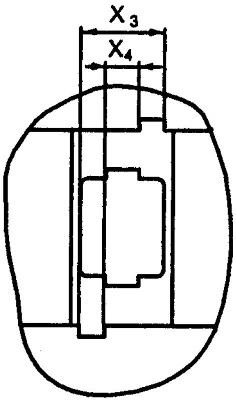


Figure 2

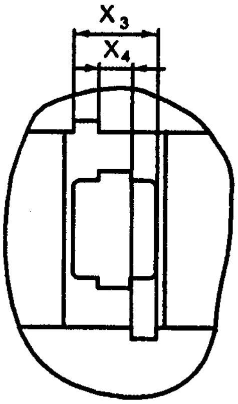


Figure 3

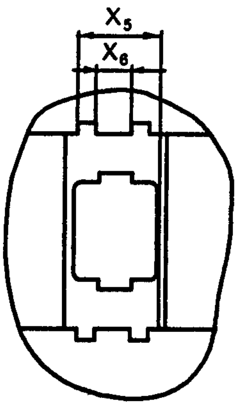


Figure 4

Only the gauge for checking G24q-1, GX24q-1, G24q-5 and GX24q-5 caps is shown.

Designation	*Figure*	*Reference*	*Dimension*	*Tolerance*
G24d-1 GX24d-1 G24q-1 GX24q-1 G24q-5 GX24q-5	1	X_2	6.6	+ 0.01 0
G24d-2 GX24d-2 G24q-2 GX24q-2 G24q-6 GX24q-6	2	X_3	12.4	+ 0.01 0
		X_4	6.2	0 – 0.01
G24d-3 GX24d-3 G24q-3 GX24q-3 G24q-7 GX24q-7	3	X_3	12.4	+ 0.01 0
		X_4	6.2	0 – 0.01
G24d-4 GX24d-4 G24q-4 GX24q-4	4	X_3	9.6	+ 0.01 0
		X_4	5.4	0 – 0.01

Reference	*Dimension*	*Tolerance*	*Reference*	*Dimension*	*Tolerance*
A	28.5	+ 0.05 0	P	21.0	+ 0.01 0
D_1	23.0	– 0.005 – 0.005	T	4.7	+ 0.01 0
D_2	8.0	– 0.005 – 0.005	Y	5.5	+ 0.1 0
E	2.79	+ 0.01 0	a	55	+ 0.5 – 0.5
E_1	2.67	+ 0.01 0	b	45	+ 0.5 – 0.5
E_2	2.29	0 – 0.01	c	4	0 – 0.2
F_1	6.0	0 – 0.025	d	16	+ 0.1 – 0.1
F_2	6.8	+ 0.025 0	g	33.5	+ 0.1 – 0.1
K_1	16.3	+ 0.01 0	r_3	0.5	+ 0.05 – 0.05
L_1	13.9	+ 0.01 0	r_4	0.2	+ 0.05 – 0.05
N_1	0.5	+ 0.01 0	r_5	0.2	+ 0.05 – 0.05

NOTE — These hoes shall be neglected for checking caps G24d-1, G24d-2, G24d-2, G24d-3, G24d-4, GX24d-1, GX24d-2, GX24d-3 and GX24d-4.

PURPOSE — To check the maximum cap-outline with respect to dimensions $K_{1\ \mathrm{Max}}$, $L_{1\ \mathrm{Max}}$, P_{Max}, $r_{3\ \mathrm{Min}}$, $r_{4\ \mathrm{Max}}$, $r_{5\ \mathrm{Min}}$, and the dimensions F_{Min}, F_{Max}, E_{Min}, E_{Max}, the combined displacement and width of the keys of caps G24d-1, G24d-2, G24d-3, G24d-4, GX24d-1, GX24d-2, GX24d-3, GX24d-4, G24q-1, G24q-2, G24q-3, G24q-4, G24q-5, G24q-6, G24q-7, GX24q-1, GX24q-2, GX24q-3, GX24q-4, GX24q-5, GX24q-6 and GX24q-7 on finished lamps respectively.

TESTING — The centre post and pins of the cap shall enter the gauge at surface *O* and when fully inserted, the reference plane of the cap and surface *O* of the gauge shall contact.

In this position the ends of the pins shall be co-planar with or project beyond surface f_1 but they shall not project beyond surface f_2. It shall be possible to insert each pin in turn into hole e_1 until the reference plane of the cap and surface *x* of the gauge contact.

It shall not be possible to insert the pins, other than the extreme tips, into hole e_2.

7006-78-4

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